

added:—"All this is the roughest possible, but I think if worked out in detail the result would not be widely different. The greatest care would, of course, be necessary to guard against submarine explosives." To this letter Sir John Burgoyne replied that he doubted whether 5 inches of iron would answer its intended purpose and make a vessel practically impregnable. In this connection he remarked:—"Iron is very treacherous, and breaks, rends, and tears under very irregular effort. The Navy have a thorough dislike to it for the sides of ships, but then they have never contemplated, I believe, such thickness."

These remarks from so high an authority on ordnance as Sir John Burgoyne throw an interesting light upon opinions prevailing little more than fifty years ago in regard to naval construction. Lord Rosse was not discouraged, but proceeded to press his scheme upon the attention of the Duke of Newcastle and on Sir Baldwin Walker, who was then Controller of the Navy. In his letter to the Duke of Newcastle, Lord Rosse stated that he "had been considering, no doubt in common with many others, in what way the great mechanical resources of England could be brought to bear against the mechanical resources of St. Petersburg." In thus writing, Lord Rosse no doubt had in view the fact that iron-clad floating batteries had been decided upon. Five such vessels were commenced in France in September, 1854, and later on similar vessels were built here, but not from Lord Rosse's outline design.

In the publication of these letters a filial duty has been fulfilled. The late Lord Rosse is shown to have been one of the first to make a definite proposal for the construction of ironclad floating batteries, and his treatment of the subject is worthy of his scientific reputation. On the other hand, it cannot be doubted that the action taken in France was independent of the suggestions of the late Lord Rosse. The correspondence with Sir John Burgoyne, the Duke of Newcastle and others could not have been known to the Emperor Napoleon when he took action; the construction of the French floating batteries was commenced about the same time as these letters were written, but was preceded by experimental trials made to determine the thickness of the armour to be adopted. It may be added that General Paixhans, to whom the introduction of horizontal shell-fire was due, had proposed the use of armour protection for ships about 1820, and Mr. Stevens began the construction of a floating battery near New York many years before the Crimean War took place. Lord Rosse obviously had no knowledge of these facts when he made the proposals above described, and acted quite independently.

THE SMITHSONIAN INSTITUTION.

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1907, has been received. It serves admirably to show the great part taken by the institution in American scientific life. Full particulars are provided, not only of the explorations and researches inaugurated by the institution, but also of the work of the U.S. National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, the Astrophysical Observatory, the Regional Bureau of the International Catalogue of Scientific Literature, and the excavations on the Casa Grande Reservation—all placed by Congress under the direction of the institution.

Reference has already been made from time to time in these pages to the researches prosecuted in connection with the institution, but it will be of interest to refer to a few which are summarised in the report. In connection with the study of the older sedimentary rocks of North America, on which Dr. Charles D. Walcott, the secretary of the institution, has been engaged during the past twenty years, upwards of 20,000 feet of strata have been carefully examined and measured. The Cambrian section has been found to include more than 12,000 feet of sandstones, shales, and limestones, and the Lower, Middle, and Upper Cambrian have been found represented in the section of Bow River series and the Castle Mountain group. Characteristic fossils have been found in each division.

An expedition in April, 1907, to Alaska to collect the remains of large extinct vertebrates, particularly mammals, has already done good work. Dr. G. P. Merrill has examined the crater-form depression near Canyon Diablo, Arizona, to determine whether it was caused by explosive volcanic action or is due to the impact of a mass of meteoric iron; his observations are being collated and arranged.

In connection with the seismological investigations undertaken to compare the disturbance in Chile with that in California, it seems to have been determined that there has been some elevation of the coast of Chile, but no traces of a rift such as caused the earthquake at San Francisco. Numerous other researches were assisted during the year: these included the absolute measure of sound, the properties of matter at very low temperatures, the study of the upper air, the organs of flight, and others.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate recommends that the necessary steps be taken for altering Statute B, chapter vi., by the insertion of a paragraph giving the University power, upon the retirement of a professor, either at the date of his retirement or subsequently, to appoint him as a professor emeritus in the subject of the professorship previously held by him. A professor emeritus shall not as such receive any stipend, and shall be subject to no conditions as to duties or residence.

Dr. W. N. Shaw, of Emmanuel College, has been appointed to represent the University at the meeting of Imperial and colonial meteorologists, convened by the Royal Society of Canada, to be held at Ottawa in May.

Mr. J. S. Gardiner has been re-appointed demonstrator in animal morphology for five years as from October 1, 1907, and the appointment has been approved by the special board for biology and geology.

The special board for biology and geology reports that the Gordon Wigan income for biology and geology has been applied during 1907 as follows:—(a) a grant of 50*l.* a year to Dr. D. Sharp for a period of three years (1907–9), or such part of it during which he holds the curatorship in zoology; (b) a grant of 50*l.* a year for one year (1907) to Prof. Seward to enable the Botanic Gardens Syndicate to offer greater facilities for plant-breeding experiments; (c) a grant of 50*l.* out of the income for 1907 to Prof. Hughes, to enable Mr. E. A. N. Arber, of Trinity College, to continue his researches into the stratigraphical and geographical distribution of fossil plants.

LORD STANLEY OF ALDERLEY will distribute the prizes and certificates to evening students of the Battersea Polytechnic on Wednesday evening, February 19, and will deliver an address.

We learn from the *Pioneer Mail* that the Maharaja of Darbhanga has made a gift of nearly 17,000*l.* to the Lieutenant-Governor for the purpose of constructing a library building in connection with the Calcutta University.

THE annual general meeting of the Association of Technical Institutions will be held on February 21 and 22 at the Drapers' Hall, Throgmorton Street, London. On the first day the association will be entertained at luncheon by the Drapers' Company, after which the new president, Sir Norman Lockyer, K.C.B., F.R.S., will deliver his presidential address. On the second day papers will be read on the best early training for a boy about to enter a technical institution or to take up a trade.

IN a recent report, the Director of Education for the United Provinces has, in accordance with the orders of the Government of India, described the progress of education in his district during the last five years. An abridgment of the report in the *Pioneer Mail* states that the attendance at the Thomason Civil Engineering College at Roorkee has increased from 336 to 495, and various improvements in and extensions of the curriculum have been effected. An agricultural college has been opened at Cawnpore. It is hoped that the medical college at Lucknow will be in working order soon. The Thomason College will, it is

expected, shortly develop into a technological institute for engineering purposes, and a technological institute for chemical matters will be established at Cawnpore. Another matter of high importance referred to in the report is the change recently made with the object of introducing more practical work into the course for the degree of Bachelor of Science—a necessary step to meet the growing demand for good teaching in science, which is evidenced by the doubling, in five years, of the number of affiliated colleges preparing for science degrees, and a large increase in the number of undergraduates studying science.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 12, 1907.—"On the Scattering of the β Rays from Uranium by Matter." By J. A. Crowther. Communicated by Prof. J. J. Thomson, F.R.S.

The results of the experiments described are summarised as follows:—

(1) A parallel pencil of β rays is scattered in its passage through matter, the scattering being practically complete after the rays have traversed a thickness of material which varies from 0.015 cm. for aluminium to 0.0002 cm. for gold.

(2) The scattering, after correction for the loss of energy, due to the absorption of the rays may be represented by an equation of the form $I/I_0 = e^{-\sigma d}$, where d is the thickness of the material traversed by the rays, and σ is the coefficient of scattering for the rays, I_0 being the initial intensity of a narrow parallel pencil of β radiation, crossing a small fixed cross-section of the pencil, and I the intensity crossing the same cross-section when a thickness d of material is placed in the path of the beam at a considerable distance from the fixed cross-section.

(3) The ratio of the coefficient of scattering σ to the coefficient of absorption λ is approximately constant for all the substances measured, its average value being about 13. The values of the ratio σ/ρ , where ρ is the density, show similar variations to those for λ/ρ .

December 12, 1907.—"Preliminary Note on the Operational Invariants of a Binary Quantic." By Major P. A. MacMahon, F.R.S.

Mineralogical Society, January 21.—Prof. H. A. Miers, F.R.S., president, in the chair.—Zeolites from the neighbourhood of Belfast: F. N. A. Fleischmann. The author gave an account of a number of hitherto unrecorded zeolite localities near Belfast which he visited in November last. The localities described are quarries in the lower basalt of the neighbouring hills, the most important being two, the first situated on the north side of the hill, which is locally known as Cat Carne, the second on the north-east slopes of Collinward. The first quarry is the most prolific in zeolites in the neighbourhood, yielding fine specimens of apophyllite, analcite, chabazite, levynite, faerolite, &c. In the second quarry cavities are rare, but when they occur are, as a rule, large, and are usually lined with colourless tabular apophyllite crystals which reach sometimes an inch and a half across, and are associated with large hemispherical aggregates of natrolite.—Strüverite and its relation to ilmenorutile: Dr. G. T. Prior and Dr. F. Zambonini. The mineral was found in the pegmatite of Craveggia, N. Piedmont. In its crystallographic characters it is almost precisely similar to rutile, tapiolite, and ilmenorutile (F. Z.). Chemically (G. T. P.) it is closely related to ilmenorutile, and contains titanite, niobite, and tantalite acids with oxide of iron, in proportions corresponding approximately with the formula $\text{Fe}(\text{TaNb})_2\text{O}_6 \cdot 4\text{TiO}_2$. At first it was thought to contain zirconia as an essential constituent; the supposed zirconia, however, was shown on further examination to consist of niobite and tantalite acids, which, after the fusion of the mineral with KHSO_4 and treatment with water, had passed into solution with the titanite acid. In the presence of as much titanite acid as occurs in strüverite (40 per cent.) it was found that the greater part of the niobite and tantalite acids could thus pass into solution, and when a dilute solution of sulphuric acid (5 per cent. H_2SO_4) was used instead of water in treating the melt obtained

with KHSO_4 , the whole passed into solution. New analyses of ilmenorutile from the Ilmen Mountains and from Norway showed that the titanite acid has been previously much over-estimated, and is present, in the first case, only up to 53 per cent., and in the other to about 54½ per cent. The mineral from the Ilmen Mountains was also found to contain tantalite acid up to about 15 per cent. The most reasonable view of the composition of these minerals appears to be that they are solid solutions of tetragonal rutile (TiO_2) with the crystallographically similar tetragonal moscovite or tapiolite, $\text{Fe}(\text{TaNb})_2\text{O}_6$.—Twin structure: Dr. John W. Evans. The author adopts as a definition of a twin crystal that it is a crystal consisting of two component parts such that (a) parallel lines in general have not the same physical characters in the same direction in the two components; (b) one or more "twin-planes" exist such that all lines parallel to (1) any line in a twin-plane, or (2) the "twin-axis" normal to a twin-plane, have the same physical characters in the same or opposite directions in the two components. He shows that this definition includes all twins by reflection, rotation, or inversion (= reflection + rotation), and divides twin-crystals into eleven classes according to the odd or even cyclic characters of the twin-axis, the relations between the terminations of the twin-axis, and the relations between the disposition in space of the structure of the two components. He describes twins as amphitetic, homotetic, or antitetic according as lines parallel to the twin-plane have in both components the same physical characters (1) in both directions; (2) in the same directions; or (3) in the opposite directions.—A simple method of drawing crystals of calcite and other rhombohedral crystals, and of deducing the relations of their symbols: Prof. W. J. Lewis. The author described a simple method of drawing crystals of calcite and other rhombohedral crystals, in which the principal axis and the twin-axis lie in the plane of the paper. The method is not well adapted for showing simple forms, but with combinations and twinned crystals the drawings closely resemble ordinary clinographic drawings, and are much more easily and rapidly constructed. The geometrical relations between the faces and the relations between the Millerian and Naumannian symbols are readily followed from these drawings. Some unusual twinned crystals of calcite were shown and described; one shows the form {917} twinned on {011}, and another {13.0.11} twinned on the same law.—The structure of perovskite from the Burgomer Alp, Pfäfersthal, Tyrol: H. L. Bowman. The examination of the optical properties and etching figures of transparent cubic crystals from this locality confirms the interpretation of the structure of perovskite proposed by Baumhauer from the study of crystals from the Ural Mountains and from Zermatt. The crystals are mimetic, and belong to the orthorhombic system, the "cubes" being formed by a combination of basal pinacoid {001} and a prism {110} with an angle of 90° , and having a lamellated structure due to twinning about faces of {110} and {111}.

Geological Society, January 22.—Sir Archibald Geikie, K.C.B., Sec.R.S., president, in the chair.—The origin of the pillow-lava near Port Isaac in Cornwall: Clement Reid and Henry Dewey. The Upper Devonian strata around Port Isaac consist of marine slates, in which occurs a sheet of pillow-lava. The pillows measure usually from 2 feet to 5 feet in diameter, but range up to 8 feet. The individual pillows are disconnected. Their mutual relations seem to prove that they were soft when deposited. Each pillow shows internally a central vacant space or open sponge, succeeded by a thick shell of vesicular lava, followed by a shell of banded rock. The whole mass is so vesicular that it must have been very light. The association with fine-grained marine strata shows that this lava was probably submarine. The specific gravity of the whole mass must have been low, not greatly exceeding that of sea-water. The lava seems to have been blown out into thick-walled bubbles. The mass was for a time in the spheroidal state, and the sheet could flow like a liquid. This eruption seems to have been analogous to that of Mont Pelée, described by Dr. Tempest Anderson and Dr. Flett, except that it was submarine instead of subaerial.—The subdivision of the Chalk at Trimmingham (Norfolk): R. M. Brydone.